MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

VOL. XXV. DECEMBER, 1897. No. 12

INTRODUCTION.

The MONTHLY WEATHER REVIEW for December, 1897, is based on 2,916 reports from stations occupied by regular and voluntary observers, classified as follows: 147 from Weather Bureau stations; numerous special river stations; 32 from post surgeons, received through the Surgeon General, United States Army; 2,567 from voluntary observers; 96 received through the Southern Pacific Railway Company; 23 from Life-Saving stations, received through the Superintendent United States Life-Saving Service; 31 from Canadian stations; 20 from Mexican stations; 7 from Jamaica, W. I. International simultaneous observations are received from a few stations and used, together with trustworthy newspaper extracts and special reports.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Meteorologist to the Government Survey, Honolulu; Dr. Mariano Bárcena, Director of the Central Meteorological Observatory of Mexico; Mr. Maxwell Hall, Government Meteorologist, Kingston, Jamaica; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; and Commander J. E. Craig, Hydrographer, United States Navy.

The REVIEW is prepared under the general editorial supervision of Prof. Cleveland Abbe.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to generally conform to the modern international system of standard meridians, one hour apart, beginning with Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are generally corrected to agree with the eastern standard; otherwise, the local meridian is mentioned.

STORM WARNINGS AND WEATHER FORECASTS.

By Lieut. Col. H. H. C. DUNWOODY, Supervising Forecast Official.

Under this head it is proposed to make note of all extreme and injurious weather conditions occurring during the month, and the warnings of the same issued by the Bureau, with instances, as far as reported by observers or the press, in which these warnings were of special public benefit. The signals displayed by the Weather Bureau will be referred to as "information," "storm," "hurricane," "cold wave," and "norther," respectively.

The following notes have been collected.

No very severe or destructive storms occurred during the month.

The injurious weather conditions of most marked note were the frosts and freezing weather that occurred in the citrus fruit districts of California on the 2d and 3d and from the 16th to the 22d, inclusive. On the former dates the temperature fell to considerably below freezing as far south as Los Angeles and Riverside counties, but the injury to the fruit interests was probably small. Concerning the latter period, Mr. W. H. Hammon, forecast official, in charge of the Weather Bureau office at San Francisco, reports:

Beginning with Wednesday night, December 15, and continuing until December 22, inclusive, temperatures at least approximating and in some places falling below the danger point were experienced in the citrus regions of California. On the nights of December 15, 16, and 17 probably no injury resulted, although it will be observed that the Riverside Press on December 17 records a temperature of 26° and states that extensive efforts at protection were employed. On Saturday a very slight depression moved southward across southern California, which had probably been moving from the northeast across Utah and southern Nevada during the two days previous. This caused light showers in southern California, followed by clearing weather and north winds Saturday night. In some sections in the vicinity of Ontario and Pomona the wind ceased, so as to allow serious frost Sunday morning, the temperature falling to 21° and 24° in low places. The most injurious frost was Sunday night, December 19, when the temperature in Redlands, San Bernardino, and Riverside varied in places from 21° to 32°. On the nights of the 20th and 21st almost as severe frost occurred, which probably increased the injury, owing to the continuation of the cold.

From no section has as full and reliable information been received regarding the severity of the frost as from Riverside, and the lowest record that I have been able to find from that section is 22°, and that well down on the side of an arroyo. The temperatures, as a rule, ranged between 24° and 28° in sections in which in December, 1895, they ranged from 20° to 24°. The temperatures recorded at Pomona, San Bernardino, and Redlands this year were as low as those recorded in 1895.

It is difficult to determine the extent of the injury in the citrus region. In northern California the crop was nearly all marketed, and the greater portion of that still on the trees was picked after the warning was received, and consequently the injury was slight. In southern California the Los Angeles Express places the injury between 10 and 20 per cent; the Riverside Press, from 15 to 25 per cent; and the Los Angeles Herald, at one-third of the crop. Probably the estimate of the Riverside Press is the most nearly correct.

Warnings of these frosts were issued by the Weather Bureau in every instance on the morning of the day preceding their occurrence.

On the morning of the 2d the forecasts for the following day were: "For northern California, decidedly colder to-night, with killing frost; smudging necessary for citrus fruits. For southern California, killing frost, injurious to citrus fruits; smudging necessary." On the morning of the 3d the forecasts were: "For northern California, heavy frosts to-night. For southern California, killing frost to-night."

Concerning the forecast of the 2d, Mr. Hammon reported that it was somewhat more severe than was warranted, but that he preferred to have the error made in that direction rather than that a serious frost should occur without a sufficient warning being given, as the expense of protection was slight in comparison with the injury that would result without protection.

On the morning of Wednesday, the 15th, forecast was made of killing frost for Thursday, the 16th, with "some danger to citrus fruit Thursday night," and a similar forecast was repeated daily until Saturday, the 18th. From Saturday evening, the 18th, to Wednesday, the 22d, the forecast read, "killing frost, probably injurious to citrus fruit." These warnings were given the most complete and effective distribution possible throughout the threatened regions. All persons receiving forecasts on the daily forecast card received these warnings. The telephone company distributed them to every exchange in the State, and the Southern Pacific Company and San Francisco and San Joaquin Valley Railway Company notified all their agents.

The benefits of these warnings to the fruit growers in enabling them to secure large quantities of the crop before it was harmed and to protect the remainder from injury is universally admitted to have been immense. It is stated that nearly every large orchard is now provided with excellent means for preventing or diminishing injury from frost, and undoubtedly every possible means of protection was used in these instances. It was probably due in a measure to this protection that so little injury resulted from the frosts of the 3d and 4th, and the value of the fruit saved from damage through these means during the freezing weather of the 16th to 22d is estimated at approximately a million dollars.

It is thought reasonable to believe that the fact that the temperatures reported from Riverside during this freeze were on the average about 4° higher than those of 1895, while the temperatures reported from Pomona, San Bernardino, and Redlands were about the same as in 1895, was due largely to the more extensive use of protective measures in the first-named district.

The freeze had the effect of drawing increased attention to and putting to practical test the various means of protection that have been heretofore suggested or devised, and also of arousing a general interest in and discussion of the region, climate, and conditions best adapted to the successful culture of citrus fruit. Among the means of protection used at this time may be mentioned the burning of moist straw, or "smudging," steam apparatus, water spraying, baskets of burning coal, and buckets of burning oil and tar. The last-named method was claimed in one instance to have raised the temperature of the orchard where it was used 5° above that of the surrounding locality.

Suggestion was made that the general protection of fruit from injury by cold was a matter of such public interest and involved so great expense and such extensive preparation and cooperation that it might be justly made a public charge and provided for by a tax levy.

Investigations were made as to the temperature inside and outside the fruit at which injury began, with the result of fixing the former at from 31° to 28°, and the latter at from 26° to 24°.

Several experiments were made with the X rays, in order to determine from the photographs whether the fruit had suffered injury or not.

From many articles on this subject in the public press the following are selected:

Los Angeles, Cal., Daily Herald, December 2, 1897.—A killing frost and stiff northerly winds are predicted for southern California to-night. A heavy storm and a cold wave prevailed in Utah and Nevada yesterday, and southern California will not escape, as the atmospheric disturbance is traveling this way.

The Weather Bureau announced the frost early yesterday, thirty-six hours in advance of the arrival of the vegetation destroyer. The orange and lemon growers and others whose products are liable to injury are thus warned in ample time to take steps for the protection of their crops. To-day should be a busy day with them. Of course the whole of southern California will not be affected alike, but precautions should be taken at all points where there is danger of a killing frost.

The prediction of frost so far in advance of its coming shows that the weather service has taken great strides forward in recent years. It pays for itself many times over in thus giving warning of storms, frost, and other elemental disturbances. It often occurs nowadays that ships put out to sea or remain in port in accordance with the suggestions of the Weather Bureau, thereby escaping danger and possible loss. A single warning of this kind has saved millions of dollars in property on the Atlantic coast.

San Bernardino, Cal., Sun, December 3, 1897.—The message that was sent from the Weather Bureau Wednesday, announcing a heavy killing frost for Friday morning, caused consternation throughout the whole citrus belt of southern California. It meant danger to millions of property at a time when the loss would come heavy on the fruit grower. The orange crop this season is exceptionally large and the prices good. A freedom from frost would lift the burden from hundreds of struggling horticulturists, while a frost means disaster to them.

Yesterday afternoon the Southern Pacific Company sent out to all their agents and conductors strict orders to sound the alarm to every place on their lines throughout the State and disseminate the news as broadcast as possible through the following dispatch:

"All agents. Weather Bureau forecast: Cold weather and killing frosts in Sacramento and San Joaquin valleys to-morrow, Friday, morning. Also killing frosts in southern California orange sections and a few miles back from coast. The bureau recommends smudging of all orange groves to-night to prevent great loss. Advise all conductors so they may notify and spread this information."

The first warning came twenty-four hours in advance and was heeded throughout the whole valley. The thermometer was closely watched by hundreds of anxious people all last night to notice each change for the worse. At 6 p. m. last evening it marked 42°.

At midnight the mercury had dropped to 30°, when a slight warm wind came from the southwest and the thermometer rose rapidly, and at 2 a. m. it stood at 36°, and the danger was over.

There are many ways of diminishing the danger from frost practiced by the orange grower. To turn on the irrigating water through the orchard is a great help.

In the Everest orchard of Riverside, along the upper side, is a series of large tanks filled with crude petroleum. From each one runs a pipe down through the orchard, with laterals. From the latter fine streams of oil drop into iron kettles, and when lighted the orchard is warmed and smudged at the same time. It is claimed that the temperature can be raised in this way from 8° to 12°. Many growers place windrows of hay through every other row of trees, and dampen it, so it will send up a cloud of steam and smoke burning slowly. This is an excellent way to keep off the frost and is very successful.

Coal tar in vessels, when set on fire, throws up a dense smoke. This is good, but it affects the fruit, giving it a smudge that needs to be cleaned off before packing the fruit.

A wire screen with a fire underneath and wet straw or coarse, damp manure on top is said to be excellent to raise a steam and smudge.

There are a dozen other ways to keep the frost at bay, the main idea being to raise an artificial cloud that will prevent the moisture from settling on the fruit and turning to frost there. A slight breeze is a sure preventive. In Rialto there is scarcely a night in the year but there is a breeze sweeping over it, and frost to damage oranges has hitherto been unknown there.

San Francisco, Cal., California Fruit Grower, December 25, 1897.—The citrus fruit-growing districts of California have lately experienced the effects of a cold wave of unusual length. The daily weather map and bulletin of the United States Department of Agriculture bearing date Wednesday, December 15, over the name of W. H. Hammon, forecast official, in charge, had this for southern California: "Fair to-night and Thursday; colder to-night, with frost in the interior; some danger to citrus fruit Thursday night." Every day since then, up to and including December 21, the forecast for that section has been for injurious frosts, but worded more strongly.

San Francisco, Cal., Call (editorial), December 22, 1897.—So much criticism, both flippant and caustic, is visited upon the Weather Bureau

whenever it makes a mistake in forecasts that it is only fair commendation should be given when by some conspicuous act of useful service it demonstrates its value to the community. Such service it has just rendered in giving warning to the orange growers of the coming of the cold snap, thus enabling them to prepare in time for guarding, as far as possible, against injury by frosts.

It is yet too early to venture upon estimates of the amount of damage done by frosts, or to calculate how much was saved in the orchards where the growers smudged or resorted to other devices to keep the temperature of their orchards above the danger point. Enough is known, however, to make it certain that the loss in some localities has been very great, and that it would have been greater but for the warning sent by the Weather Bureau.

Taking all things into consideration, there is probably no department of the public service in which the Government renders so much benefit to the people in proportion to its cost as the Weather Bureau, and the value of the service increases with each succeeding year. It would be more valuable if the people understood better how to profit by its warnings. For that reason it is to be desired that some data be gathered of the results obtained from the various means of guarding against frost in the present instance, so that the best method of avoiding the danger in future may be made known.

Albany, N. Y., Press and Knickerbocker, January 3, 1898.—A practical demonstration of the value to agriculturists of the bulletins of the Weather Bureau was given last week in the fruit-growing districts of southern California. Extreme cold was predicted in Los Angeles, Riverside, and Bernardino counties, and, in fact, the mercury fell to 10° below freezing, the lowest temperature registered in that part of the country for twenty-five years. With ripe and ripening oranges on the trees this would have meant, but for the hoisting of the danger signal, a complete loss of the fruit. Careful estimates show the quantity of fruit ready for marketing thus put in jeopardy to have been 10,000 carloads, or 2,000,000 boxes, amounting in value, at $3 a box, to $6,000,000. About one-fifth of the crop is supposed to have been gathered in at the first warning of the Weather Bureau, and the dilatory or skeptical owners of the other four-fifths doubtless wish that they had reposed greater trust in the official meteorologists.

Sacramento, Cal., Record Union, December 23, 1897.—Whatever poking of fun may have been indulged in in the past at the expense of the Weather Bureau service, and there has been all too much of it, it must be conceded now that the Bureau has in the recent service in this cold spell been accurate and of greatest benefit to the people of the whole of this coast. The fact is that the Bureau, as a rule, has been all along accurate in its forecasts. We are prone to find fault with it when, like all human institutions, it has been in error, while we are not given to awarding full credit for all its beneficence when reliable and correct. For that it is a good doer, whoever is honest and just must admit. The American people have every reason to be proud of the Weather Bureau, and to be satisfied with the service it gives the country. Let those who have carped and complained pause long enough to contemplate the blotting the service from our system. Let them reflect upon what would be the result of being deprived of that which has now become so much more than a convenience, a necessity.

Los Angeles Sunday Times, December 26, 1897.—The facts about the citrus fruit industry in southern California are no longer difficult of comprehension. They are, indeed, so plain that "he who runs may read."

When, twenty-five years ago, orange trees were first planted in this section on a commercial scale, little or nothing was known by the pioneers of the industry regarding the proper conditions attendant on the planting and cultivation of citrus fruit. Quite naturally orange groves were planted on the level lands, where the necessary water for irrigation was available. Hence, we find that a majority of the older groves are the worst damaged whenever a severe frost occurs.

The true citrus belt of this continent, on the Pacific coast, extends from the latitude of Santa Barbara, on the north, southward, through southern California and Mexico, to Central America. It is here narrow, there wide, according to local conditions. Even within the limits of a quarter of a section of land there may be local climatic conditions which must be studied.

North of the Tehachapi range are, here and there, narrow sheltered strips of land in the foothills, upon which citrus fruit may be raised with fair prospect of success, in ordinary seasons, even as far north as Butte County, but the farther north one goes the smaller is the area of such lands, and the greater the care which must be exercised in planting orange or lemon groves.

The fact is that the whole of southern California is on the northern edge of the true citrus belt of the Western Hemisphere, and we must govern ourselves accordingly. Those who, influenced by enterprising real estate agents or by inadvertence, plant citrus trees outside of the safety line must be content to take their chances. The area of safe citrus land in southern California, while in the aggregate quite important, bears only a very small relation to the total area of the seven southern counties, and from year to year Jack Frost defines his boundaries more plainly. All who are interested in the permanent prosperity of this section should see to it that strangers are not led to delude themselves on this score.

It would well pay the citrus fruit growers of southern California to club together and buy the orange and lemon groves that have been planted in localities visited by damaging frosts every two or three years, cut down the trees, and replant the land with some tree or crop more adapted to the climate.

Los Angeles Daily Times, December 22, 1897.—In this connection it might be well to note certain experiments which have been made this year. At Pomona tests have been made by a representative of The Times, and by J. W. Mills of the Experiment Station, to determine the degree of cold requisite to congeal orange juice. It was found that at a temperature of 28° in the interior of the orange, which had occurred three times during December, and which is the lowest temperature yet found, the juice showed the presence of ice, though water congeals at a temperature of 32°. Mr. Mills, however, placed open dishes of water and orange juice side by side, and determined that ice was present in the juice before the water froze, but in the juice it was in the nature of floating crystals, not all the juice congealing, while the water eventually froze solidly. This would indicate that an orange might be frozen sufficiently to burst the juice cells without this being evident to the eye when cut open.

The effect of frost on oranges is to burst the juice cells, leaving the juice to float through the fruit, from which in time it is either drawn back into the tree, or finds its way through the pores of the rind and evaporates. In the course of time, which is hastened by warm weather, the fruit becomes flabby and light in weight, while eventually spots appear upon the rind, indicating the beginning of decay. If immediately picked, this fruit can be sent to market and consumed without attracting attention, and there is no reason to believe that, as long as it is firm and of practically normal weight, it is unwholesome. But when, in the course of about two weeks, the fruit becomes flabby and juiceless, it is neither palatable nor wholesome. It is not always easy to determine whether an orange is seriously injured or not. If only a few of the cells are broken, the orange will lose but slightly in weight, the loss in weight increasing in proportion to the loss of juice. A box or oranges naturally weighs about 70 pounds. If it falls to 60 pounds it may still rank as good fruit, though not fancy, while if it drops to 50 pounds it is undoubtedly not a wholesome food. As a single tree may contain sound fruit, fruit that is badly frozen, and fruit in all intermediate stages, and as the condition of the fruit can only be determined by weight as the expert packers handle them, it is evident that, even in view of great care, some of the comparatively light fruit must be marketed.

On the other hand, when a grower sees his crop injured, his desire to save himself as far as possible from loss often prompts him to pick and market the oranges as rapidly as possible, and it has been the case following previous frosts that the shipments reached an abnormal condition immediately after the frost, while those who had gilt-edge fruit would not market it in view of the certainty of a demoralized market. These shipments rarely bring returns of consequence, as the fruit is generally known to be frosted and the market breaks under the pressure. Whether that will result this year is doubtful. It is certainly to be hoped that no inferior fruit will be sent out.

If the oranges are not picked after the frost, in the course of a month nature begins to segregate the sound fruit from that which is frozen, by throwing the latter to the ground; and, so far as the frosts of this month are concerned, it can be said that when the market rallies from the holiday trades, about February 1, it will be too late to receive any oranges which are badly frozen, as they will then be on the ground.

Eastern dealers and consumers need have no suspicion of oranges which reach them under the brand of fancy fruit. The packers have labored for years to build up a reputation for their brands, and while it is possible that some frosted fruit will find its way to market, it is certain that no reputable house will ship such freight under a brand which has a reputation with eastern dealers.

The fact that the frost has trodden paths where its footprints were discernible before simply once more emphasizes the necessity of adapting the cultivation of the soil to the climate and other conditions which prevail.

Los Angeles, Cal., Daily Herald, December 24, 1897.—There is another view of the case that must not be lost sight of. These occasional cold waves have served to demonstrate the fact that there are warm belts and there are cold belts throughout the State. The lowlands are subject to damaging frosts, while the higher slopes of the valleys, nearer the mountains or foothills, are not subject to damaging frost. Years ago this fact was not so well known as it is to-day. The lowlands were more easily irrigated than the higher slopes, and hence they were, as a rule, the first to be planted. Hence, many of the first orange orchards in southern California were planted in localities where no one would to-day think of planting either the orange or the lemon tree. As the people realized the fact that the higher slopes of the valleys were comparatively free from frost, they began to plant their citrus trees on those slopes.

FREEZING WEATHER IN THE TEXAS SUGAR AND VEGETABLE REGIONS.

Freezing temperatures occurred in the sugar and vegetable

regions of Texas on the 3d and 4th, concerning which Dr. I. M. Cline, local forecast official and section director in charge of the Weather Bureau Office at Galveston, reports:

As the a. m. weather map of Thursday, December 2, 1897, showed very unsettled conditions and the possibility of temperatures injurious to sugar and trucking interests in this section during Friday, noon special observations were called for from authorized stations in Texas, Oklahoma, and Kansas, * * * and the following special forecast was made and distributed at 2:45 p. m.: "Temperature may fall to 40° at Galveston, and to 32° at points 50 to 100 miles from Galveston Friday."

The following temperatures were recorded Friday in the district for which the forecast was made: Galveston, 37.5°; Brenham, 30.0°; Columbia, 36.0°; and Missouri City, 32.0°.

The 8 a. m. weather map of Friday, December 3, 1897, indicated freezing to the coast line, and the following special forecast was included with regular a. m. local forecast: "Freezing, with minimum temperature at Galveston 30°, and 50 to 100 miles from Galveston, 24° Saturday morning."

The following temperatures were recorded Saturday in the district for which the forecast was made: Galveston, 30.0°; Brenham, 23.5°; Columbia, 27.0°; Missouri City, 26.0°.

Continued low temperature was forecast for Sunday morning, and freezing occurred again near the coast.

Prompt action was taken on the receipt of the warnings to protect the various crops in this section.

The following are from reports received at this office as to special benefits derived:

E. H. Cunningham & Co., Sugarland, Tex., say:

"Warning of December 2, received twenty-four hours before the freeze. Twelve hundred acres of sugar cane standing in the fields when warning received. Three hundred acres cut and windrowed before freeze set in, and five hundred acres additional cut on strength of warning of December 3. The service was of great value to us, enabling us to get sufficient cane in windrow before freeze came to enable us to save entire crop."

William Dunovant, Eagle Lake, Tex., says:

"Warning received about twelve hours in advance of the norther; cane farms immediately notified by telephone; every knife possible was put in the cane, and water and steam pipes drained. Value of property protected, $4,000. Cane left standing was only partially damaged, so the loss would not have been entire had none been cut; estimated value saved $1,000."

C. F. Mercer, Missouri City, Tex., says:

"Warning received about sixteen hours before freeze; perishable vegetables covered up to the value of $1,000. Special warnings are of great value and we would like them continued."

The vegetable interests in this vicinity are large and half the perishable crops were protected and saved from material injury. It is estimated that the value of that saved to truck farmers is $5,000. Exposed water pipes to the value of $10,000 (estimated) were drained and saved from injury.

A reasonable estimate of the property protected from the freeze in this vicinity as a result of the warnings of December 2 and 3 is $50,000.

AREAS OF HIGH AND LOW PRESSURE.

By Prof. H. A. HAZEN.

During the month there were seven highs and twelve lows sufficiently well defined to be charted, and their apparent tracks will be found on Charts I and II. The principal facts regarding the place of origin or the region where first seen, and the region of disappearance or where they were last seen, their duration and velocity will be found in the accompanying table.

HIGHS.

Of the seven highs five were first noted to the north of Montana, but could not be traced to the Pacific. The other two were first noted off the middle Pacific Coast. The apparent movement of I was nearly south to Texas and then east to the Atlantic. Number III moved east and south from middle Pacific Coast and disappeared in extreme east Texas. The remaining highs moved east and southeast, and all disappeared off the Atlantic Coast. The temperature conditions accompanying these highs were remarkably moderate. Only one severe cold wave occurred during the month as high V moved southeast from the north of Montana on 15th and 16th; a. m. of 15th the temperature fell 40° in twenty-four hours at Helena and reached —4°; at Williston the fall was 38° and to —10°; p. m. of 15th the temperature fell 44° at Denver and reached 2°. Morning of 16th the cold wave extended to the Mississippi Valley; the temperature fall at Pueblo was 40°, at Sioux City and Concordia was 34°, and at Omaha, Dodge City, and Amarillo it was 32°. On morning of 17th this cold wave was much diminished, and it continued diminishing till the high disappeared off the New England Coast p. m. of 20th.

LOWS.

Of the lows, six were first noted off the north Pacific Coast, one to the north of Montana, one off the south Pacific Coast, three in the west Gulf, and one in the upper Lake Region. The apparent motion of these lows was toward Newfoundland, where eight were last noted; the others were last seen in the upper Lake Region. As low V approached the Atlantic Coast the wind reached 56 miles an hour at Block Island p. m. of the 14th. As low XII approached the upper Lakes it caused a wind of 56 miles an hour at Chicago, and as it came near the lower Lakes, morning of the 30th, the wind at Buffalo reached 56 miles an hour.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	*29, a. m.	53	117	6, p. m.	33	78	3,120	7.5	416	17.3
II	4, p. m.	52	108	9, a. m.	46	57	2,730	4.5	607	25.3
III	8, p. m.	37	124	11, p. m.	32	108	1,550	3.0	517	21.5
IV	10, p. m.	38	125	16, a. m.	33	81	3,410	5.5	620	25.8
V	14, a. m.	53	118	20, p. m.	41	69	3,040	6.5	468	19.5
VI	22, a. m.	53	105	25, p. m.	37	74	1,940	3.5	554	23.1
VII	26, a. m.	52	101	30, p. m.	28	80	3,080	4.5	673	28.0
Total							18,880	35.0	3,855	
Mean of 7 tracks							2,689		551	22.9
Mean of 35 days									538	22.4
Low areas.										
I	*29, a. m.	48	128	2, p. m.	49	52	3,910	3.5	1,117	46.5
II	1, a. m.	33	116	6, a. m.	49	54	3,960	5.0	786	32.8
III	4, p. m.	49	127	7, p. m.	46	79	2,280	3.0	760	31.7
IV	7, a. m.	49	128	13, a. m.	46	59	4,030	7.0	576	24.0
V	10, p. m.	47	127	16, p. m.	48	56	4,790	6.0	798	33.2
VI	13, a. m.	48	126	16, a. m.	48	87	2,680	3.0	893	37.2
VII	16, p. m.	26	99	19, p. m.	47	55	2,840	3.0	947	39.5
VIII	19, p. m.	30	96	21, p. m.	47	55	2,200	2.0	1,100	45.8
IX	21, a. m.	48	82	23, a. m.	48	79	340	2.0	170	7.1
X	23, p. m.	54	111	26, p. m.	47	76	1,800	3.0	600	25.0
XI	25, a. m.	29	89	27, p. m.	47	58	2,100	2.5	840	35.0
XII	27, a. m.	48	129	31, a. m.	49	64	2,960	4.0	740	30.8
Total							33,860	44.0	9,327	
Mean of 12 tracks							2,822		777	32.4
Mean of 44.0 days									770	32.1

*November.